z/VM Reference Guide

z/VM and IBM System z ***...strengthening your virtualization environment***

October 2009

Table of Contents

What is z/VM?

The z/VM® hypervisor offers a base for customers who want to exploit IBM virtualization technology on one of the industry's best-of-breed server environments, the IBM System z® family, including the IBM System z10™ Enterprise Class (z10™ EC) and the IBM System z10 Business Class® (z10 BC™). The z10 EC™ is designed to reduce energy usage and save floor space. With increased capacity and the number of available processor units per server, the z10 EC virtualization capabilities can support more virtual servers than any of its competitors, hundreds to thousands of virtual servers in a single footprint. The z10 BC further extends the leadership of System z in key capabilities with the delivery of expanded scalability for growth and large-scale consolidation, availability to help reduce risk and improve flexibility to respond to changing business requirements, and improved security. When consolidating onto System z you can create virtual servers on demand, achieve network savings through HiperSockets™ (internal LANs), and improve systems management of virtual servers. With System z virtualization, customers can easily create many virtual machines consisting of virtualized processors, communications, memory, networking, and I/O resources. Virtualization technology may help lower your total cost of ownership when deploying new enterprise application workloads. z/VM includes over 40 years of innovation and invention.

z/VM version 5 release 4 - Extending virtualization technology leadership for System z

- *Scalabilty and constraint relief enhancements*
  - *Move specific CP data structures above the first 2 GB of main storage may help improve performance and scalability for systems with more than 2 GB of storage, particularly those supporting large virtual storage environments*
  - *Remove the constraint that restricted Discontiguous Saved Segments (DCSS) to being defined below 2047 MB in virtual storage helps to allow many DCSSs to be used together*
  - *Support for the System z dynamic capabilities to help reduce the need to re-IPL z/VM by dynamically adding processors, channels, OSA adapters, and now memory to both the z/VM system itself and to individual guests*
- *Virtualization technology and Linux® enablement*
  - *Guest support for Crypto Express3 on the System z10 with the PTF for APAR VM64656, targeted to be available in November, 2009, plans to provide*
    - *The ability to dedicate any available domain to a guest for clear-key and secure-key cryptographic functions*
    - *The ability for guests to share available, non-dedicated domains for clear-key cryptographic functions*
    - *Enhancements to the CP QUERY CRYPTO APQS command to display user information about both shared and dedicated cryptographic domains*
  - *Additional support for Linux on System z guests using Dynamic Storage Reconfiguration (DSR) with the PTF for APAR VM64524*
    - *Allows operation when running second level on z/VM to be more compatible with operation when running directly on an LPAR*
  - *Redistributiion of a CPU's share to z/VM virtual processors to help allow virtual machines to be managed more efficiently*
  - *Capability to dump Linux on System z guests to Fibre Channel Protocol (FCP)-attached SCSI disks*
- *Technology exploitation*
  - *Expanded its guest support for specialty processors to allow all processor types (CPs, IFLs, zIIPs, zAAPs, and ICFs) on a System z10 server to be defined in the same z/VM LPAR*
  - *Recognizes all four ports on System z10 OSA-Express3 Gigabit Ethernet (GbE) and 1000BASE-T Ethernet features and two ports on the GbE and 1000BASE-T 2P features on the z10 BC providing more physical connectivity to service*

the network and reducing the number of required resources (I/O slots, I/O cages, fewer CHPIDs to define and manage). Includes four-port exploitation for OSA-ICC on the 1000BASE-T Ethernet feature planned for the first quearter 2010.

- *Provide I/O device information from the input/output definition file (IODF) using Hardware Configuration Definition (HCD) for the World-Wide Port Name (WWPN) prediction tool with the PTF for APAR VM64579 on a System z10 server*
- *Support for FICON® Express8 that is designed to provide faster access to data with a link data rate of 8 gigabits per second (Gbps) on a System z10 server*
- *Guest support for the IBM Extended Address Volumes (EAV) feature on the IBM DS8000 that provides for volumes that can scale up to approximately 223 GB (262,668 cylinders) with the PTF for APAR VM64709. CMS support is also doubled, up to 65,520 cylinders, for its own use with the PTF for APAR VM64711. Both PTFs are planned to be available by year-end 2009.*
- *Support for the IBM FlashCopy® SE feature on the IBM DS8000™ which provides a space-efficient snapshot capability that can greatly reduce the storage capacity needed for point-in-time copies with the PTFs for APARs VM64449, VM64605, and VM64684*
- *Support for the IBM System Storage™ Enterprise 3592 Tape Drive Model E06 with the PTFs for APARs VM64458 and VM64459*
- *Additional PTFs must be applied to support the z10 BC:*
  - *EREP support requires the PTF for APAR VM64475*
  - *CMS IOCP support requires the PTF for APAR VM64474 (also required for z10 EC)*
  - *HCD support requires the PTF for APAR VM64410 (also required for the z10 EC)*
  - *OSA/SF support requires the PTF for APAR OA26286 (also required for the z10 EC)*
- *Network virtualization*
  - *TCP/IP for z/VM stack enhancements*
    - *Dynamically discovers the Maximum Transmission Unit (MTU) size of a given IPv4 or IPv6 Internet/intranet path*
    - *Operates in Layer 2 [of the Open Systems Interface (OSI) reference model] mode*
    - *Enhances usability of managing virtual networks, including the z/VM virtual switch*
    - *Provides an IPv6-capable TELNET server and client*
- *Security enhancements*
  - *OSA-Express3 and OSA-Express2 QDIO data connection isolation providing additional networking security with the PTFs for APARs VM64463 and PK67610 and required minimum MCLs*
  - *SSL server that operates in a CMS environment instead of previous releases that required a Linux distribution with the PTFs for APARs PK65850, PK73085, PK75268, VM64540, VM64519, and VM64570*
  - *z/VM LDAP has been upgraded to the function level of the z/OS® V1.10 IBM Tivoli® Directory Server for z/OS*
  - *RACF® Security Server FL540 provides the capability to create LDAP change log entries in response to updates to RACF group and user profiles, including changes to user passwords and password phrases*
- *Systems management enhancements*
  - *Additional function provided by the HMC and Support Element (SE) 2.10.1 to exploit the z/VM System Management APIs to allow selected virtual resources to be defined and managed*
  - *Enhanced Systems Management API functions to manage Linux and other virtual machines*
  - *New function level for Directory Maintenance Facility (DirMaint™) FL540*
    - *End-user can use DirMaint to set a password phrase in an External Security Manager (ESM) and authenticate using the password phrase*

- *New function level for the Performance Toolkit for VM™ (FL540)*
  - *Displays an optional "Banner" page that can be customized*
  - *Provides updated displays and reports to support new monitor data*
- *Serviceability enhancement*
  - *Splitting a single dump into multiple files with the PTF for APAR VM64495 allows many smaller files to be stored on multiple DASD devices instead of requiring a single, larger disk*
- *Installation, service, and packaging changes*
  - *z/VM can be installed in an LPAR and both z/VM and Linux on System z can be installed in a virtual machine from the HMC DVD drive without requiring any external network setup or a physical connection between an LPAR and the HMC*
  - *Installation process has been changed to provide more information to determine the installation status*
- *Application enablement*
  - *New XL C/C++ for z/VM compiler*
  - *Language Environment® has been updated to the level shipped with z/OS V1.9*

z/VM version 5 release 3 – Enhancements in scalability, security, and virtualization technology

- *Scalabilty and constraint relief enhancements*
  - *Support for larger LPARs up to 256 GB of real storage (memory) and more than 1 TB of total virtual memory in use by guests. The actual amount of usable real and virtual memory is dependent on the amount of real memory in the z/VM logical partition.*
  - *Up to real 32 processors in a single z/VM image*
  - *Improved memory management algorithms to help benefit paging workloads with large memory environments with the PTF for APAR VM64349*
  - *Support for the Collaborative Memory Management Assist (CMMA) by which host and guest exchange information to optimize their use and management of memory (Refer to the z/VM V5.3 Performance Report for CMMA usage.)*
  - *Enhanced memory utilization using Virtual Machine Resource Manager (VMRM) between z/VM and Linux guests*
- *Virtualization technology and Linux enablement*
  - *Guest support for Crypto Express3 on the System z10 with the PTF for APAR VM64656, targeted to be available in November, 2009*
  - *Guest support for specialty processors, the IBM System z Application Assist Processors (zAAPs) and System z9® Integrated Information Processors and System z10 Integrated Information Processors (zIIPs) including:*
    - *Simulation support - z/VM guest virtual machines can create virtual specialty processors on processor models that support the same types of specialty processors but don't necessarily have them installed. Virtual specialty processors are dispatched on real Central Processors (CPs), allowing users to assess the operational and CPU-utilization implications of configuring a z/OS system with zIIP or zAAP processors without requiring the real specialty processor hardware.*
    - *Virtualization support - z/VM can create virtual specialty processors for virtual machines by dispatching the virtual specialty processors on corresponding real specialty processors of the same type, which may help improve your total cost of ownership by allowing available zAAP and zIIP capacity not being used by z/OS LPARs to be allocated to a z/VM LPAR hosting z/OS guests running Java™ and DB2® workloads*
  - *Usability enhancements for the virtual switch (VSWITCH) and guest LAN environments including enhanced ease-of-use for Virtual LAN (VLAN) and promiscuous mode configuration changes*
  - *Guest use of Modified Indirect Data Address Words (MIDAWs) to allow more flexibility and performance in certain channel programs as an alternative to data-chained channel-command words (CCWs)*

- *Guest access to the system ASCII console to facilitate recovery of the guest during an emergency*
- *Additional enhancements to Small Computer System Interface (SCSI) disk support for Linux users*
- *Secure Sockets Layer (SSL) server support for additional Linux distributions*

- *Technology exploitation*
  - *Guest exploitation of the System z10 EC and z10 BC at the level of System z9 functionality with the PTFs for APARs VM64180 and VM64242*
  - *Recognizes all four ports on System z10 OSA-Express3 Gigabit Ethernet (GbE) and 1000BASE-T Ethernet and two ports on the GbE and 1000BASE-T 2P features on the z10 BC (requires the PTFs for APARs VM64277 and PK50120). Includes four-port exploitation for OSA-ICC on the 1000BASE-T Ethernet feature planned for the first quarter 2010*
  - *Support for FICON Express8 that is designed to provide faster access to data with a link data rate of 8 gigabits per second (Gbps)*
  - *Exploitation of selected functions of the System z10 EC and z10 BC including:*
    - *Dynamic I/O configuration to define, modify, and query a Coupling using InfiniBand® link, CHPID type CIB, when z/VM V5.3 is the controlling LPAR for dynamic I/O*
    - *Processors dynamically added to or removed from a z/VM LPAR in reserve without preplanning with the PTFs for APARs VM64249, VM64323, and VM64389*
    - *Hardware Configuration Definition (HCD) provides I/O device information from the input/output definition file (IODF) for the WWPN prediction tool with the PTF for APAR VM64579 onSystem z10 server*
    - *Support for FICON Express8 that is designed to provide faster access to data with a link data rate of 8 gigabits per second (Gbps) on a System z10 server*
    - *Support for the IBM System Storage Enterprise 3592 Tape Drive Model E06 with the PTFs for APARs VM64458 and VM64459*
    - *TCP/IP and VSWITCH gaining the performance benefit of OSA-Express3*
    - *Additional PTFs must be applied to support the z10 EC and z10 BC:*
      - *EREP support requires the PTFs for APARs VM64367 and VM64475*
      - *CMS IOCP support requires the PTFs for APARs VM64302 and VM64474*
      - *HCD support requires the PTFs for APARs VM64020 and VM64410*
      - *OSA/SF support requires the PTFs for APARs OA23824 and OA26286*
  - *Support for Dynamic Volume Expansion simplifying disk management by allowing for the dynamic increase of a DS8000 volume size in order to accommodate application data growth with the PTFs for APARs VM64305 and VM64354*
  - *Support for the Hyper Parallel Access Volume (HyperPAV) function of IBM System Storage DS8000 series*
  - *Enhanced FlashCopy support allows:*
    - *Specification of up to 12 target minidisks*
    - *Determination of the status of FlashCopy requests*
    - *Exploitation of hardware asynchronous cache destage and discard*
  - *Support for the IBM System Storage SVC Storage Engine 2145 allows Linux on System z guests of z/VM V5 (all releases) to access IBM System Storage disk Subsystems, including the IBM DS4000™ series, IBM XIV® Storage System and OEM SCSI disk devices*
- *Network virtualization*
  - *Enhanced ease-of-use for virtual networks*
  - *Enhanced failover support for IPv4 and IPv6 devices*
  - *Virtual IP Address (VIPA) support for IPv6*

- *VSWITCH support for OSA-Express2 and OSA-Express3 link aggregation for increased throughput providing more seamless nondisruptive failover in the event that an OSA port in the group becomes unavailable*
- *New port isolation security mechanism provides the ability to restrict guest-to-guest communications within a VSWITCH with the PTF for APAR VM64281*

- *Security enhancements*
  - *OSA-Express3 and OSA-Express2 QDIO data connection isolation providing additional networking security with the PTFs for APARs VM64463 and PK67610 and required minimum MCLs*
  - *New LDAP server and associated client utilities*
  - *Enhanced system security with support for longer passwords (password phrases)*
  - *z/VM SSL server enhancements designed to help improve security*
  - *Tape data protection with support for encryption*
    - *Encryption Re-Key support provides the capability to update a previously encrypted tape cartridge with a new set of Key Encryption information to help allow for a continuous protection of tape cartridge data with the PTF for APAR VM64260*
- *Systems management enhancements*
  - *Enhanced Systems Management API with sockets-based server and new functions to manage virtual machines*
  - *z/VM systems management functions to be performed from the HMC to manage guests without having to establish additional network connections and reducing complex configuration of the system*
  - *New function level for Directory Maintenance Facility (DirMaint)*
  - *Enhancements to the Performance Toolkit for VM*
    - *Correct display of the System z10 and System z9 processor models with the PTF for APAR VM64369*
  - *Enhanced guest configuration with a new COMMAND statement*
- *Serviceability enhancement*
  - *Splitting a single dump into multiple files with the PTF for APAR VM64495 allowing many smaller files to be stored across multiple DASD devices instead of requiring a single, larger disk*
- *Installation, service, and packaging changes*
  - *Additional DVD installation options*
  - *RSCS repackaged as a priced, optional IPLA feature that can be licensed for IFL and standard processors*
  - *New RACF Security Server for z/VM*

A solution that builds on z/VM hypervisor strengths

- *Virtualization technology*
- *Guest operating system support*
- *Extensive connectivity options*
- *Linux server consolidation platform*
- *CMS interactive support*
- *Server support*
- *Client/server workstation synergy*
- *Open distributed computing*
- *Ideal Web serving platform*
- *Wide range of environments and applications*

For a complete list of publications available, refer to the z/VM Web site at:

ibm.com/zvm/library/

z/VM supports a wide range of industry standards

- *Networking protocols and connections, languages, programming and graphical user interfaces (GUI)*
- *POSIX support*
- *FICON and SCSI support*

z/VM manages the enterprise

- *Dynamic system configuration capabilities help reduce planned and unplanned outages*

- *DFSMS/VM provides automated data management for Shared File System (SFS), POSIX Byte File System (BFS) files, and minidisk restructuring*
  - *Provides interfaces for Tivoli Storage Manager™ (TSM) tape library usage*
  - *Allows VSE/ESA™ or z/VSE™ guest access to automated tape libraries containing 3480, 3490, 3590, and 3592 devices*
  - *Support for approximately 1 TB SCSI disks with the PTF for APAR VM63664*
  - *Multi-user tape support with the PTF for APAR VM63746*
  - *Tape encryption support for z/VSE guest with the PTF for APAR VM64062*

z/VM embraces the latest technology

z/VM version 5 release 4 provides:

- *Support for the System z dynamic storage-reconfiguration capability helps reduce the need to re-IPL z/VM by dynamically adding processors, channels, OSA adapters, and memory to both the z/VM system itself and to individual guests*
- *Capability to dump Linux on System z guests to FCP-attached SCSI disks*
- *Additional support for Linux on System z guests using Dynamic Storage Reconfiguration with the PTF for APAR VM64524*
  - *allows operation when running second level on z/VM to be more compatible with operation when running directly on an LPAR*
- *Increased flexibility by expanding z/VM guest support for specialty processors to allow all processor types (CPs, IFLs, zIIPs, zAAPs, and ICFs) on a System z10 to be defined in the same z/VM LPAR to:*
  - *Operate z/TPF, z/VSE and z/OS guests on CPs*
  - *Operate Linux on System z as guests on IFLs and optionally on CPs*
  - *Offload z/OS system software process requirements, such as DB2 workloads, on zIIPs*
  - *Provide an economical Java execution environment under z/OS on zAAPs*
  - *Operate coupling facility virtual machines in support of a Parallel Sysplex® test environment on ICFs and optionally on CPs*
- *Recognition of all four ports on System z10 OSA Express3 GbE and 1000BASE-T Ethernet features and two ports on the GbE and 1000BASE-T 2P features on the z10 BC provides more physical connectivity to service the network and reduces the number of required resources (I/O slots, I/O cages, fewer CHPIDs to define and manage). Includes four-port exploitation for OSA-ICC on the 1000BASE-T Ethernet feature planned for the first quarter 2010*
- *Guest support for Crypto Express3 on the System z10 with the PTF for APAR VM64656, targeted to be available in November, 2009*
- *Guest support for the IBM Extended Address Volumes (EAV) feature on the IBM DS8000 that provides for volumes that can scale up to approximately 223 GB (262,668 cylinders) with the PTF for APAR VM64709. CMS support is also doubled, up to 65,520 cylinders, for its own use with the PTF for APAR VM64711. Both PTFs are planned to be available by year-end 2009.*
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- *Support for the IBM FlashCopy SE feature on the IBM DS8000 which provides a space-efficient snapshot capability that can greatly reduce the storage capacity needed for point-in-time copies with the PTFs for APARs VM64449, VM64605, and VM64684*

- *Additional systems management enhancements are provided by the HMC and Support Element (SE) 2.10.1 exploiting the z/VM System Management APIs to allow selected virtual resources to be defined and managed*
- *OSA-Express3 and OSA-Express 2 QDIO data connection isolation providing additional networking security with the PTFs for APARs VM64463 and PK67610 and required minimum MCLs*
- *TCP/IP for z/VM stack enhancements:*
  - *Operates in Layer 2 (of the Open Systems Interface (OSI) reference model) mode*
  - *Provides an IPv6-capable TELNET server and client*
- *Upgraded z/VM LDAP server to the function level of the z/OS V1.10 IBM Tivoli Directory Server for z/OS*
- *Support for the IBM System Storage Enterprise 3592 Tape Drive Model E06 with the PTFs for APARs VM64458 and VM64459*

z/VM version 5 release 3 provided:

- *Support for larger LPARs up to 256 GB of real memory and more than 1 TB of total virtual memory in use by guests The actual amount of usable real and virtual memory is dependent on the amount of real memory in the z/VM logical partition*
- *Support for up to 32 real processors in a single z/VM image*
- *Improved memory management algorithms to help benefit paging workloads with large memory environments with the PTF for APAR VM64349*
- *Support for the Collaborative Memory Management Assist (CMMA), by which by host and guest exchange information to optimize their use and management of memory (Refer to the z/VM V5.3 Performance Report for CMMA usage.)*
- *Guest exploitation of the System z10 at the level of System z9 functionality with the PTFs for APARs VM64180 and VM64242*
- *Exploitation of selected functions of the System z10 including:*
  - *Processors dynamically added to or removed from a z/VM LPAR in reserve without preplanning with the PTFs for APARs VM64249, VM64323, and VM64389*
  - *Support for FICON Express8 that is designed to provide faster access to data with a link data rate of 8 gigabits per second (Gbps)*
  - *TCP/IP and VSWITCH gaining the performance benefit of OSA-Express3*
  - *Recognizing all four ports on System z10 OSA-Express3 Gigabit Ethernet (GbE) and 1000BASE-T Ethernet and two ports on the GbE and 1000BASE-T 2P features on the z10 BC (requires the PTFs for APARs VM64277 and PK50120). Includes four-port exploitation for OSA-ICC on the 1000BASE-T Ethernet feature planned for the first quarter 2010*
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  - *Hardware Configuration Definition (HCD) provides I/O device information from the input/output definition file (IODF) for the WWPN prediction tool with the PTF for APAR VM64579*
  - *Additional PTFs are required*
- *Support for the HyperPAV function of IBM System Storage DS8000 series*
- *Support for Dynamic Volume Expansion simplifying disk management by allowing for the dynamic increase of a DS8000 volume size in order to accommodate application data growth with the PTFs for APARs VM64305 and VM64354*
- *Enhanced FlashCopy support that allows:*
  - *Specification of up to 12 target minidisks*
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- *Exploit hardware asynchronous cache destage and discard*
- *Support for the IBM System Storage SVC Storage Engine 2145*
- *Guest support for specialty processors, the System z zAAPs and System z9/System z10 zIIPs:*
  - *Simulation support - z/VM guest virtual machines can create virtual specialty processors on processor models that support the same types of specialty processors but do not necessarily have them installed. Virtual specialty processors are dispatched on real Central Processors (CPs), allowing users to assess the operational and CPU-utilization implications of configuring a z/OS system with zIIP or zAAP processors without requiring the real specialty processor hardware.*
  - *Virtualization support - z/VM can create virtual specialty processors for virtual machines by dispatching the virtual processors on corresponding real specialty processors of the same type, which may help improve your total cost of ownership by allowing available zAAP and zIIP capacity that is not being used by z/OS LPARs to be allocated to a z/VM LPAR hosting z/OS guests running Java and DB2 workloads*
- *Guest use of MIDAWs*
- *z/VM systems management functions to be performed from the HMC to manage guests without having to establish additional network connections and reducing complex configuration of the system.*
- *Guest access to the system ASCII console to facilitate recovery of the guest during an emergency*
- *Additional enhancements of SCSI disk support for Linux users*
- *OSA-Express3 and OSA-Express 2 QDIO data connection isolation providing additional networking security with the PTFs for APARs VM64463 and PK67610 and required minimum MCLs*
- *VSWITCH support for OSA-Express2 and OSA-Express3 link aggregation for increased throughput and providing more seamless nondisruptive failover in the event that an OSA port in the group becomes unavailable*
- *Enhanced failover support for IPv4 and IPv6 devices*
- *VIPA support for IPv6*
- *New LDAP server and associated client utilities*
- *Enhanced system security with support for longer passwords (password phrases)*
- *Tape data protection with support for encryption*
  - *Encryption Re-Key support provides the capability to update a previously encrypted tape cartridge with a new set of Key Encryption information to help allow for a continuous protection of tape cartridge data with the PTF for APAR VM64260.*
  - *Support for the IBM System Storage Enterprise 3592 Tape Drive Model E06 with the PTFs for APARs VM64458 and VM64459*

z/VM provides support for running Parallel Sysplex system environments

- *z/OS Parallel Sysplex system environments as z/VM guests*
- *Virtual Coupling Facility (CF) support:*
  - *Helps provide faster deployment of new Parallel Sysplex systems through testing with virtual sysplexes*
  - *Does not require or support real hardware coupling facilities and coupling links*
  - *Support Coupling Facility duplexing with System z*
  - *Allows z/VM systems hosting sysplexes to run as second-level (or higher) guests*
  - *Help reduce risk in running new applications for z/OS releases*
  - *Helps reduce problems in scheduling test and production time*
  - *Helps reduce training expense and risk to production operations through operator training with virtual configurations*

  - *Provides additional options for disaster recovery*
- *z/VM V5 supports the Parallel Sysplex guest environment on all models of the IBM z10 EC, z10 BC, z9 EC, z9 BC, z990, z900, z890, and z800 servers.*

z/VM encompasses many uses

- *Flexible, cost-effective guest environments*
- *Well-suited for on demand business*
- *Consolidation of select UNIX® and Linux workloads onto a single physical hardware server*
- *Data and application serving for Internet/intranet users*
- *Rich application development environment*

z/VM for On Demand Business

- *Access to enterprise data and applications through TCP/IP NFS*
- *Enterprise Web serving through IBM Business Partner products working cooperatively with z/VM*
- *Reusable Server Kernel (RSK) for vendors and application programmers to write multithreaded server programs*

VM installation and service tools

- *Virtual Machine Serviceability Enhancements Staged/ Extended (VMSES/E) available for:*
  - *Installation of z/VM, IBM Licensed Products, and vendor products in VMSES/E format*
  - *Allows the service disks of the z/VM components to reside in SFS*
  - *Application of z/VM service*
    - *CORrective service (COR)*
    - *Recommended Service Upgrades (RSU)*
    - *RSUs in OMA/2 format have been discontinued for all currently supported and future releases*
- *Installation available on 3590-formatted tapes and DVD on V5.2 and later*
- *Installation available on 3592-formatted tapes with V5.3 and later*
- *Installation from 3480-formatted tapes was discontinued with V5.4 and later*
- *Order z/VM products and service using ShopzSeries*
  - *Internet delivery of z/VM base, optional features, and SDO licensed products*

To learn more about ShopzSeries:

ibm.com/software/ShopzSeries/

CMS application multitasking

- *Applications can be divided to handle work in parallel*
- *Application throughput can be improved*
- *POSIX exploits CMS multitasking*
- *CMS Pipelines support the use of CMS multitasking*

CMS Pipelines

- *Programmer productivity tool for simple creation of powerful, reusable REXX™ and Assembler programs and Common Gateway Interface (CGI) scripts for Web servers*

Data-in-memory exploitation

- *Virtual disk in memory provides fast access to data in memory*
- *Minidisk cache boosts performance with cache in main and/or expanded storage (memory)*
- *VM Data Spaces allow applications in virtual machines to create additional VM data spaces of 2 GB, up to 2 TB total*

Callable Services Library (CSL)

- *Enhanced application development productivity*
- *REXX and other high-level languages can use z/VM services, such as requesting Shared File System functions*
- *Interfaces to use VM data spaces*
- *Interfaces to POSIX functions for CMS users and applications*

CMS Interactive Support

CMS Binder/Loader for z/VM

- *Enhanced application affinity between CMS and z/OS*
- *Upgraded to the z/OS 1.9 Binder/Loader in V5.4*
- *The CMS binder*
  - *Creates and utilizes data spaces if the user is authorized*
  - *Converts object or load modules, or program objects, into a program object and stores the program object in a partitioned data set extended (PDSE) program library*
  - *Converts object or load modules, or program objects, into a load module and stores the load module in a partitioned data set (PDS) program library*
  - *Converts object or load modules, or program objects, into an executable program in virtual memory and executes the program*
- *The CMS loader*
  - *Increases the services of the program fetch component by adding support for loading program objects*
  - *Reads both program objects and load modules into virtual storage and prepares them for execution*

VMLINK

- *User productivity enhancer for linking minidisks and SFS directories*
- *Rewritten for enhanced serviceability in z/VM*

ibm.com/vm

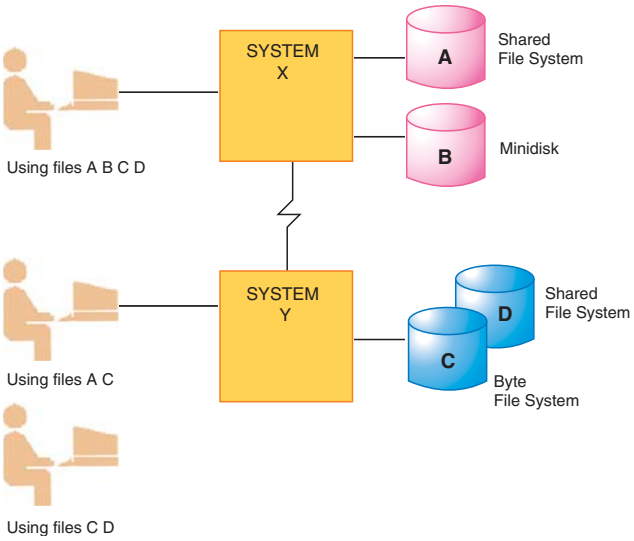
z/VM Server Support

z/VM Data Spaces are designed to:

- *Offer capabilities unique to System z family*
- *Provide high speed transfer and data access between virtual machines, helping to improve throughput and response times*
- *Allow applications to address multiple 2 GB data spaces*
- *Support data sharing between a server and multiple users*
- *Provide an application programming interface and Callable Services Library routines, exploited by DB2 for VSE and VM, SFS and FORTRAN to help*
  - *Enable customers and vendors to develop applications using z/VM Data Spaces*
  - *Make development process easier*

z/VM Shared File System (SFS) is designed to:

- *Allow read/write sharing at the file level*
  - *Provide sharing within one system or across multiple systems*
  - *Provides file security through authorization mechanism*
- *Improve performance*
  - *Utilizes minidisk caching in main or expanded storage memory*
  - *Exploits VM Data Spaces*



- *Improve usage of disk storage devices*
  - *Store data stored in file pools*
  - *Provides logical vs. physical allocation of data blocks*
  - *Makes unused blocks available to any user of file pool*
- *Improve productivity*
  - *Organizes files in hierarchical directories*
  - *Supports aliases for file names*
  - *Provides single application interface via CSL routines for SFS and minidisk data*
- *Simplify system administration*
  - *Provides file pool backup and file-level restore*
  - *Provides dynamic expansion of file space for users*
  - *Provides dynamic expansion of DASD to file pool*
  - *Allocates file pool DASD space vs. individual minidisks*
  - *Allow the same administration tools to be used for POSIX hierarchical byte file system files*
- *Use Coordinated Resource Recovery*
  - *Coordinates updates to multiple file pools*
  - *More easily developed distributed applications, with system coordination of data integrity*
- *Enable access to distributed data*
  - *Transparent access to remote data*
- *Allow CMS users and applications to access the POSIX hierarchical byte file system*
- *Shuts down automatically when the z/VM Control Program (CP) is shutdown*

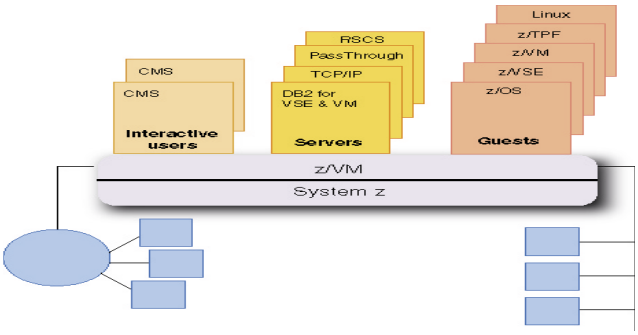
DFSMS/VM is designed to:

- *Provide automated space management*
  - *Space management for Shared File and Byte File System files*
  - *Migration, recall and expiration of active and inactive data*
  - *Archive/restore of SFS files to tape with Tivoli Storage Manager*
- *Provide a high-performance data mover*
  - *Enables fast migration to new storage devices*
  - *Near 1 TB SCSI disk support*
- *Include Interactive Storage Management Facility (ISMF)*
  - *Provides consistent interface for z/VM, z/OS storage administrators*
  - *Assists in managing minidisk data*
- *Manage IBM TotalStorage® 3494 and 3500 tape libraries and IBM System Storage TS7700 Virtualization Engine containing 3590 and 3592 drives, including support for:*
  - *Write Once Read Many (WORM) data cartridges*
  - *Disk-only tape configurations provided by the TS7720, well-suited for disaster recovery and data consolidation, protection, and sharing*
- *Provide the capability for a tape-librarian product to communicate with an automated tape library*
- *Provide ATL access for VSE guests*
- *Provide multi-user attach support allowing z/VM to be installed from 3490 tapes residing in an ATL with the PTF for APAR VM63746*
- *Provide tape encryption support for z/VSE guests with the PTFs for APARs VM64062 and VM64458*
- *Be orderable as a no-charge feature with the z/VM V5 SDO*

ibm.com/vm/related/dfsms/

Guest Operating System Support

The z/VM hypervisor concurrently supports many different virtual machines, each running its own operating environment ("guest" operating system) with security and isolation features.



Linux on System z potential guest benefits

- *Consolidation of Linux workloads on a single physical hardware server*
  - *Allows multiple Linux images on a z/VM system running IFL processors without affecting IBM software charges for existing System z standard processors in the same hardware server*
- *Improved memory management algorithms to help benefit paging workloads with large memory environments with the PTF for APAR VM64349*
- *Enhanced exploitation of real memory beyond 2 GB*
- *Provides additional support for Linux on System z guests using Dynamic Storage Reconfiguration with the PTF for APAR VM64524*
  - *allows operation when running second level on z/VM to be more compatible with operation when running directly on an LPAR*
  - *displays configured, standby, and reserved values for each virtual storage element via the QUERY VIRTUAL STORAGE command*
  - *improves z/VM handling of unexpected DSR conditions that can occur*
- *Support for the Collaborative Memory Management Assist (CMMA), by which host and guest exchange information to optimize their use and management of memory (Refer to the z/VM V5.3 Performance Report for CMMA usage.)*
- *Enhanced memory utilization using VMRM between z/VM and Linux*
- *Shared disk resources creating a server farm within a single machine*
- *More Linux images operating concurrently with reduced contention on the VM scheduler lock for better performance*
- *Redistribution of a CPU's share to z/VM virtual processors to help allow virtual machines to be managed more efficiently and Linux on System z provides new function that can automatically start and stop virtual processors based on virtual processor utilization and workload characteristics*
- *Remove the constraint that restricted Discontiguous Saved Segments (DCSS) to being defined below 2047 MB in virtual storage helps to allow many DCSSs to be used together allowing larger sizes needed for Linux filesystems and block devices and Linux on System z can expand data storage capacity more easily*
- *High-performance networking among virtual machines*
- *OSA-Express3 and OSA-Express 2 QDIO data connection isolation providing additional networking security with the PTFs for APARs VM64463 and PK67610 and required minimum MCLs*
- *Support for OSA-Express2 and OSA-Express3 OSA for NCP (OSN)*
- *Enhanced performance assists for cooperating z/VM guests using OSA-Express, FCP, and HiperSockets*
- *Enhanced problem determination for guest LANs and virtual switches*
- *VSWITCH support for IEEE 802.3ad link aggregation and failover support*

- *Guest support for dedicated QDIO devices (HiperSockets, OSA-Express, and FCP channels)*
- *Attachment of SCSI devices using the System z FCP feature of all FICON Express adapters*
  - *Point-to-Point Fibre Channel links*
  - *Dynamically-determined preferred paths for emulated FBA devices (EDEVICEs) on SCSI disks in an IBM System Storage DS6000*
  - *Faster formatting of EDEVICEs on SCSI disks*
  - *Display of additional SCSI device characteristics*
  - *Guest IPL from SCSI FCP disks on servers equipped with the SCSI IPL Feature Enabler*
  - *Deploy a Linux server farm on z/VM using only SCSI FCP disks*
  - *Enhanced performance of z/VM Control Program (CP) use of SCSI disk I/O*
  - *Capability to dump Linux on System z guests to FCP-attached SCSI disks*
    - *More guest virtual memory can be dumped because SCSI disks can be larger than ECKD™ disks*
    - *Dumping on SCSI disks avoids the need to convert a VMDUMP into a Linux tool format*
    - *Allows the same SCSI dump mechanism to be used when running Linux in a logical partition (LPAR) and in a z/VM virtual machine*
  - *Enhanced FCP channel utilization and sharing among guests with NPIV support*
- *Support for the IBM System Storage SVC Storage Engine 2145 allows Linux on System z guests of z/VM V5 (all releases) to access IBM System Storage disk subsystems, including the IBM DS4000 series, IBM XIV Storage System, and OEM devices supported as emulated FBA devices for use by CP and guest operating systems is provided for z/VM V5.3 and z/VM V5.2 (with the PTF for APAR VM64128).*
- *Guest support for the IBM Extended Address Volumes (EAV) feature on the IBM DS8000 that provides for volumes that can scale up to approximately 223 GB (262,668 cylinders) with the PTF for APAR VM64709. CMS support is also doubled, up to 65,520 cylinders, for its own use with the PTF for APAR VM64711. Both PTFs are planned to be available by year-end 2009.*
- *z/VM HyperSwap™ function to help provide a coordinated near-continuous availability and disaster recovery solution for distributed applications, such as WebSphere®, that can span z/OS images running natively and Linux guests running under z/VM*
- *Publication for deploying Linux on System z with z/VM*
- *Performance Toolkit enhancements to add new high-level Linux reports and monitor records*
- *Simplified systems management using facilities provided by z/VM*
- *Systems management API for client applications to allocate and manage resources for virtual machines*
- *z/VM systems management functions to be performed from the HMC to manage guests without having to establish any external network connections or carry out complex configuration of the system*
- *Installation of Linux on System z as well as z/VM in a virtual machine from the HMC DVD drive without requiring any external network setup or a physical connection between an LPAR and the HMC*
- *Handling of unexpected workload growth by the quick addition of Linux virtual machines as needed*
- *Enhanced device support, such as virtual disks and peer-to-peer remote copy for Linux systems*
- *More flexible data transfer with virtual switch exploitation of Layer 2 support for OSA-Express, OSA-Express2, and OSA-Express3*
- *Increased number of TCP/IP stacks*
- *With corresponding function from Linux on System z, Linux guest virtual machines may benefit from:*
  - *Enhanced page-fault handling*

- *Guest support for the IBM PCI Cryptographic Coprocessor (PCICC) or the IBM PCI Cryptographic Accelerator (PCICA)*
  - *Dedicated-queue and shared-queue support for clear-key cryptographic functions*
- *Guest support for the PCIX Cryptographic Coprocessor (PCIXCC) feature*
  - *Dedicated-queue and shared-queue support for clear-key cryptographic functions*
- *Guest support for the Crypto Express2/3 feature (coprocessor and accelerator)*
  - *Dedicated-queue and shared-queue support for clear-key cryptographic functions*
- *Guest support for Crypto Express3 on the System z10 with the PTF for APAR VM64656, for V5.3 and later, targeted to be available in November, 2009, plans to provide*
  - *The ability to dedicate any available domain to a guest for clear-key and secure-key cryptographic functions*
  - *The ability for guests to share available, non-dedicated domains for clear-key cryptographic functions*
  - *Enhancements to the CP QUERY CRYPTO APQS to display user information about both shared and dedicated cryptographic domains.*
- *Enhanced disk-access performance with minidisk cache*
- *Facilities to back up all Linux data providing a single backup solution for all Linux servers*
- *Strong tracing, diagnostic and debugging facilities*
- *Access to a large number of Linux applications*

z/VSE and VSE/ESA potential guest benefits

- *A state-of-the-art platform for combining the best of VSE core applications with new workloads that exploit Linux on System z*
- *Outstanding operational flexibility, simplicity, and productivity:*
  - *Multiple specialized VSE guests for test, development, and release-to-release transition*
  - *Multiple production VSE guests for system simplicity*
  - *Integration of VSE and Linux guests for server consolidation and new workloads, including WebSphere Application Server*
- *Improved performance with:*
  - *Virtual disk-in-memory exploitation, for example, shared lock file*
  - *Minidisk caching in expanded and main storage (memory)*
  - *DB2 for VSE & VM data sharing for enhanced performance*
  - *IBM TotalStorage Virtual Tape Server 3494 automated tape library access*
  - *Guest support for the Crypto Express2/3 feature (coprocessor and accelerator)*
    – Dedicated-queue and shared-queue support for clear-key cryptographic functions
  - *Guest support for Crypto Express3 on the System z10 servers with the PTF for APAR VM64656, targeted to be available in November, 2009*

z/OS potential guest benefits

- *Parallel Sysplex support for guests within a single VM image*
  - *Virtual Coupling Facility support to allow z/VM systems to run as first or second-level, or higher guests while simulating complete z/OS coupled sysplexes*
- *Testing environment for deploying applications on simulated zAAP and zIIP specialty processors*
- *Testing environment for deploying applications on real zAAP and zIIP specialty processors*
- *Expanded guest support in V5.4 for specialty processors with support for z/VM-mode partitions allowing all processor types (CPs, IFLs, zIIPs, zAAPs, and ICFs) on a System z10 to be defined in the same z/VM LPAR*

- *Modified Indirect Data Address Words (MIDAWs) to allow more flexibility and performance in certain channel programs as an alternative to data-chained channel-command words*
- *z/VM HyperSwap function to help provide a coordinated near-continuous availability and disaster recovery solution for distributed applications, such as WebSphere, that can span z/OS images running natively and Linux guests running under z/VM*
- *Guest support for the PCICA feature*
  - *Dedicated-queue support for clear-key cryptographic functions*
- *Guest support for the PCICC feature*
  - *Dedicated-queue support for clear-key and secure-key cryptographic functions*
- *Guest support for the PCIXCC feature*
  - *Dedicated-queue support for clear-key and secure-key cryptographic functions*
- *Guest support for the Crypto Express2/3 feature (coprocessor and accelerator)*
  - *Dedicated-queue support for clear-key and secure-key cryptographic functions*
- *Guest support for Crypto Express3 on the System z10 with the PTF for APAR VM64656, for V5.3 and later, targeted to be available in November 2009*
- *Guest support for Parallel Access Volumes (PAVs)*
- *Guest support for the IBM Extended Address Volumes (EAV) feature on the IBM DS8000 that provides for volumes that can scale up to approximately 223 GB (262,668 cylinders) with the PTF for APAR VM64709. CMS support is also doubled, up to 65,520 cylinders, for its own use with the PTF for APAR VM64711. Both PTFs are planned to be available by year-end 2009.*

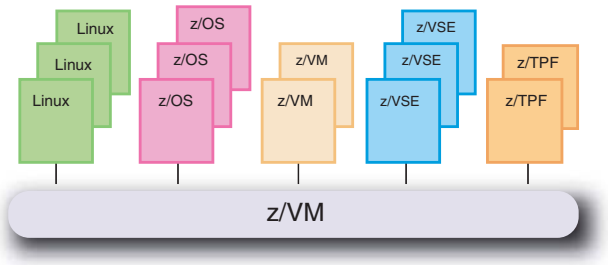
Support for z/Architecture® and ESA/390-mode operating systems

- *Performance assist support*
  - *Adapter interruption performance assist for QDIO* [1]
  - *QDIO Enhanced Buffer State Management (QEBSM) and Host Page Management Assist (HPMA)* [2]
- *Potential for hundreds to thousands of guests for migration, testing, production, and development*
- *Virtual device support*
- *Shared and dedicated resources*
- *Memory-management assist*
- *Debugging and trace facilities for guest systems*
- *64-bit guest operating systems including z/OS, z/VSE and Linux on System z*

Notes:

1) This performance assist is available only on the z10 EC, z10 BC, z9 EC, z9 BC, z990, and z890.

2) QEBSM and HPMA are supported by z/VM V5.2 and later releases and are exclusive to the z10 EC, z10 BC, z9 EC, and z9 BC.



Performance

z/VM offers many features that can help improve performance. A number of these features work by keeping frequently used data in memory, thus significantly reducing repeated I/O for the same data. The reduction in I/O can result in faster response times, improved processor efficiency and reduced load on the I/O subsystem. Minidisk caching and virtual disk in storage are two examples of the use of data-in-memory techniques in z/VM.

The degree of benefit varies with the frequency of system workload I/O that applies to these techniques, data-reference patterns, disk configuration, memory availability, and other factors.

To learn more about z/VM performance:

ibm.com/vm/perf/

Connectivity Options

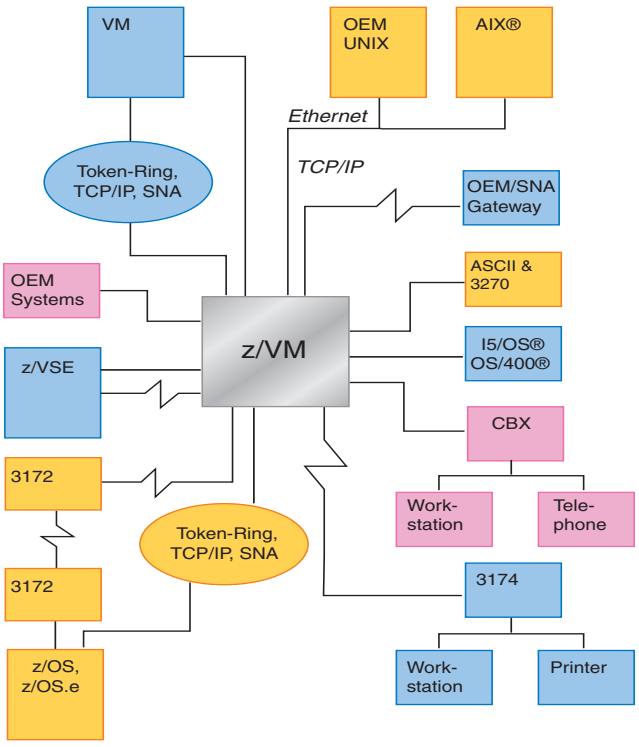
Networking options

z/VM provides a wide range of networking and connectivity options and adheres to many of the industry standards, enabling communications across distributed heterogeneous environments. Examples include:

- *SNA*
- *BSC*
- *TCP/IP*
- *Token-Ring*
- *Ethernet (GbE, 10 GbE, and 1000BASE-T)*
- *X-Windows*
- *Network File Systems*
- *Simple Mail Transfer Protocol*
- *IP Multicast*
- *X.400 mail exchange protocol*
- *NJE*

Network management

- *SNA and TCP/IP networks*



TCP/IP for z/VM V5.4 (Level 540)

- *All functions available in TCP/IP for z/VM for z/VM V5.3 plus:*
  - *Recognizes all four ports on System z10 OSA-Express3 Gigabit Ethernet (GbE) and 1000BASE-T Ethernet and two ports on the GbE and 1000BASE-T 2P features on the z10 BC providing more physical connectivity to service the network and reducing the number of required resources (I/O slots, I/O cages, fewer CHPIDs to define and manage). Includes four-port exploitation for OSA-ICC on the 1000BASE-T Ethernet feature planned for the first quarter 2010*
  - *OSA-Express3 and OSA-Express2 QDIO data connection isolation providing additional networking security with the PTFs for APARs VM64463 and PK67610 and required minimum MCLs*
  - *Stack enhancements:*
    - *Dynamically discover the Maximum Transmission Unit (MTU) size of a given IPv4 or IPv6 Internet/intranet path*
    - *Operate in Layer 2 (of the Open Systems Interface (OSI) reference model) mode*
    - *Enhance usability of managing virtual networks, including the z/VM virtual switch*
    - *Provide an IPv6-capable TELNET server and client*
  - *SSL server that operates in a CMS environment instead of requiring a Linux distribution with the PTFs for APARs PK65850, PK73085, PK75268, VM64540, VM64519, and VM64570*

Note: Operates with z/VM V5.4

TCP/IP for z/VM V5.3 (Level 530)

- *All functions available in TCP/IP for z/VM for z/VM V5.2 plus:*
  - *z/VM SSL server support for additional Red Hat and Novell SUSE Linux distributions*
  - *OSA-Express3 and OSA-Express QDIO data connection isolation providing additional networking security with the PTFs for APARs VM64463 and PK67610 and required minimum MCLs*
  - *Enhanced ease-of-use for virtual networks*
  - *Enhanced failover support for IPv4 and IPv6 devices*
  - *Virtual IP Address (VIPA) support for IPv6*
  - *New LDAP server and associated client utilities*
  - *Enhanced security with the z/VM SSL server*
  - *Recognizes all four ports on System z10 OSA-Express3 Gigabit Ethernet (GbE) and 1000BASE-T Ethernet and two ports on the GbE and 1000BASE-T 2P features on the z10 BC (requires the PTFs for APARs VM64277 and PK50120). Includes four-port exploitation for OSA-ICC on the 1000BASE-T Ethernet feature planned for the first quarter 2010*
  - *Performance benefit of OSA-Express3 on System z10*

Note: Operates with z/VM V5.3

To learn more about TCP/IP for z/VM:

ibm.com/vm/related/tcpip

ACF/VTAM version 4 release 2 for VM/ESA

- *Enhanced growth and constraint relief*
- *Increased number of users connected to a single VTAM® image*
- *Larger, more functional, less complex networks*

- *APPN® capability*
- *Low End Networking (LEN) communications to all nodes*
- *Better interconnection with multivendor networks*
- *Increased performance for on-line transaction processing*
- *Enhanced client/server access*
- *More flexible access to applications and resources across multiple platforms*

(See VTAM V4.2 for VM/ESA® Release Guide – GC31-8089)

ibm.com/software/network/vtam

RSCS optional feature of z/VM (V5.3 and later)

- *Provides unsolicited File Transfer (UFT) client and daemon support*
- *Processes NJE data traffic over TCP/IP, SNA, Bisynchronous, or directly-attached systems (CTCA, ESCON® and FICON)*
- *Provides print support to TCP/IP printer daemon in text and PostScript format*
- *Supports ASCII printers attached to protocol converters or by TCP/IP connection*
- *Enables RSCS server to be the z/VM daemon to the TCP/IP world*
- *Enables the z/VM printer daemon to access any printer attached directly or indirectly to the NJE or TCP/IP network*
- *Provides API interface to code your own*
- *Repackaged as a priced, optional IPLA feature for operation on IFL and standard processors*
- *Dynamic command authorization support eliminating the need to re-cycle RSCS when changing system and link authorizations*

(See z/VM V5R4.0 RSCS Networking Operation and use - SC24-6154)

ibm.com/vm/related/rscs

VM/Pass-Through Facility version 2

- *Multisession support for CMS and dialed users*
- *Auto sign-on support*
- *FICON Express8, FICON Express4, FICON Express2, FICON, ESCON, TCP/IP, APPC, IUCV, CTCA, 3088, Binary-synchronous connectivity options*
- *Gateway access to SNA network*
- *Connectivity to other VM, z/OS, VSE, z/VSE and AIX® systems*
- *Automated session operations*
- *Transparent, seamless solutions for end-users*
- *Sharing a single session among multiple workstations*
- *Help with low-cost workstation support for VSE guest virtual machines*
- *Screen-capture capabilities*
- *Direct support for SDLC terminal control units*
- *Cross-system IUCV support provides communications path for applications on separate VM systems to use IUCV protocols*

(See VM/Pass-Through Facility Users Guide – SC24-5555)

ibm.com/vm/related/pvm

z/VM Decision Support

VM has multiple offerings that enable the end user to transform business data into timely and accurate business decisions.

DB2 Server for VSE & VM

- *Can help improve productivity with Stored Procedures*
- *Exploits DRDA® 2 in application server for accessibility to data on local or remote systems*
- *DB2 access over a TCP/IP network from DRDA requesters*
- *Increased database availability with Incremental Archive*
- *Optional QMF™ and QMF for Microsoft® Windows® features*
- *Enables database switching*
- *Allows multiple read-only users access to all data*
- *Provides VM database access from VSE system*
- *Recovery of databases at the table and storage pool level*
- *Supports VM Data Spaces*
- *Optional database administration feature*

DB2 Server for VSE & VM V7.5

- *Latest release provides an enhanced client offering to:*
  - *Provide bind file support for VSE and VM*
  - *Provide Runtime only Client edition for VSE*
  - *Provide Runtime only Client edition for VM*
  - *Convert all online phases to AMODE 31 RMODE ANY*
  - *Plus other additional functional enhancements*

(See DB2 Server for VSE & VM Overview – GC09-2995)

ibm.com/software/data/db2/vse-vm/

Query Management Facility (QMF) Feature

- *Provides easy-to-use workstation GUI interfaces*
- *Powerful query and report writer for DB2 data*
- *Client/server capabilities for the workstation environment*
- *Processes both relational and non-relational data*
- *Connect to DB2 for Linux on System z as an application server*

(See Using QMF 7.2 – SC27-0716, and QMF 7.2 Reference Guide – SC27-0715)

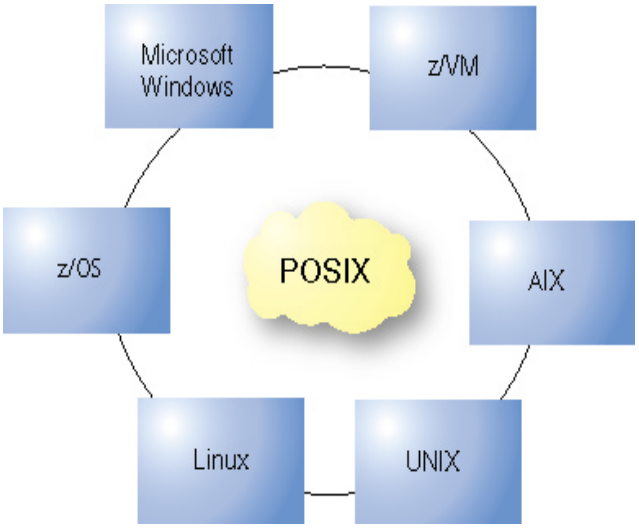
ibm.com/software/data/qmf/

Open Computing

POSIX standards

- *Extend portability and provides standards-based application-development services*
- *Define basic operating-system interfaces and behavior*
- *POSIX 1003.1c threads – Provide a general set of services for developing multitasking server applications that support multiple, concurrent execution streams*
  - *POSIX 1003.1c*
  - *POSIX 1003.1 and POSIX 1003.1a*
  - *POSIX 1003.2 – Shell and Utilities*
- *POSIX hierarchical byte file system support by CMS and SFS enables access by heterogeneous systems across LANs and WANs*

(See z/VM OpenExtensions Users Guide — SC24-6108)



Notes:

1) *The OpenExtensions Shell and Utilities is packaged with z/VM at no additional charge*

2) *DCE is not available in z/VM V5.*

Systems management APIs

- *Helps simplify the task of managing many virtual images running under a single z/VM image*
- *V5.3 provided a new sockets-based multitasking capable server*
- *Additional systems management enhancements are provided by the HMC and Support Element (SE) 2.10.1 exploiting the z/VM Systems Management APIs to allow selected virtual resources to be both defined and managed*
- *Create new virtual images in a variety of operating environments, such as Linux, z/OS, z/VM, z/VSE, z/TPF, and CMS*
- *Allocate and manage resources for virtual images and change a virtual image configuration*
- *Manage connectivity between virtual images*
- *Activate and deactivate individual and multiple virtual images*
- *Manage DASD volumes and groups*
- *Update VMRM Service Virtual Machine configuration files and query data without logging onto the VMRM server*
- *Support the directory manager's ability to manage subscriptions to directory updates and tag and scan functions*
- *Allow creation, updating, and querying of the LOADDEV directory statement for virtual images*
- *Query the time when a virtual image was activated*

(See IBM Systems Management Application Programming - SC24-6122)

Performance Toolkit for VM FL540 optional feature of z/VM V5.4

Provides enhanced capabilities for a z/VM systems programmer, operator, or analyst to monitor and report performance data:

- *Full-screen-mode system-console operation*
- *Management of multiple z/VM systems (local or remote)*
- *Post-processing of Performance Toolkit for VM history files and of VM monitor data captured by the MONWRITE utility*
- *Performance monitoring*
- *Viewing of performance monitor data using either Web browsers or PC-based 3270 emulator graphics*
- *TCP/IP performance reporting*
- *Processing of Linux performance data obtained from RMF™ which can be viewed and printed similar to the way VM data is viewed and presented*
- *Reporting for Linux and SCSI FCP disks*
- *Performance Toolkit server does not have to be shut down and restarted when adding new VM systems within the enterprise for performance-data retrieval*
- *FL540 enhancements include:*
  - *Displays an optional "Banner" page that can be customized and is presented prior to displaying the Performance Toolkit logon page that provides access to the Web interface*
  - *Provides updated displays and reports to support new monitor data for the dynamic memory upgrade enhancement*
- *FL530 enhancements included:*
  - *Support for passphrases when accessing the Performance Toolkit's Web interface*
  - *Service process for the Performance Toolkit changed from a full-part replacement MODULE to service by individual object parts, reducing the size of the service deliverable*
  - *New or updated displays and reports to support new functions*
- *Functional equivalence to PRF and RTM*

(See z/VM: Performance Toolkit for VM - SC24-6136 for V5)

ibm.com/vm/perf/toolkit

IBM Tivoli OMEGAMON® XE on z/VM and Linux V4.1.2

- *Provides statistical information about z/VM operating system resources, such as CPU, I/O, networking, memory, and DASD, as well as workload measurements*
- *Provides performance information for Linux on System z guests of z/VM for tuning Linux workloads*
- *Additional integrated monitoring of Virtual Disk (VDISK) control unit cache and DASD device cache assists in identifying bottlenecks in the I/O subsystem*
- *Wait statistics due to processor spin locks help in discovering impacts due to spin locks*

(See IBM Tivoli OMEGAMON XE on z/VM and Linux User's Guide - SC32-9489)

ibm.com/software/tivoli/products/omegamon-xe-linux-zseries/index.html

Directory Maintenance (DirMaint) FL540 optional feature of z/VM V5.4

- *FL540 allows the end-user to set a password phrase in an External Security Manager (ESM) and authenticate the password phrase*
- *Reduces indefinite wait times when a DATAMOVE machine cannot access all required resources for a DASD management function*
- *Provides a security-rich interactive facility for maintaining the system directory*
- *Simplified user administration with the coordination of DirMaint and RACF changes with z/VM V5.2 and later*
- *Enhanced directory management performance with z/VM V5.2 and later*
- *Provides distributed administration*
- *Provides commands and exits to support new functions*
- *Supports Systems Management APIs*
- *Supports the Shared File System*

(See DirMaint Facility Tailoring and Administration Guide – SC24-6135)

ibm.com/vm/related/dirmaint

Resource Access Control Facility (RACF) Security Server FL540 optional feature of z/VM V5.4

- *RACF Security Server provides:*
  - *Flexible control of access to protected resources*
  - *Protection of installation-defined resources*
  - *Ability to store information for other products*
  - *Choice of centralized or decentralized control of profiles*
  - *Transparency to end users*
  - *Includes function of the RACF for z/VM optional feature plus:*
  - *Interoperates with the TCP/IP LDAP server*
  - *Supports mixed-case passwords and passwords that are longer than eight characters, called password phrases (also known as passphrases)*
  - *FL540 has been upgraded to the function level of the z/OS V1.10 IBM Tivoli Directory Server for z/OS and also provides the capability to create LDAP change log entries in response to updates to RACF group and user profiles, including changes to user passwords and password phrases*

Note: Release-specific priced, optional feature, operating only with z/VM V5.4

(See z/VM: RACF Security Server General User's Guide — SC24-6146)

ibm.com/eserver/zseries/zos/racf/vm.html

IBM Tivoli zSecure Manager for RACF z/VM

Combines capabilities of the most used zSecure Audit and Admin functions for the virtual machine environment to:

- *Automate complex, time consuming z/VM security management tasks with simple, one-step actions that can be performed without detailed knowledge of RACF command syntax*
- *Quickly identify and prevent problems in RACF before they become a threat to security and compliance*
- *Help ease the burden of database consolidation*
- *Create comprehensive audit trails without substantial manual effort*
- *Generate and view customized audit reports with flexible schedule and events elections*

(See IBM Tivoli zSecure Manager for RACF z/VM: Installation and Configuration Manual – SC23-6574)

ibm.com/software/tivoli/products/zsecure-mgr-zvm-racf/

CMS Utilities Feature (CUF)

- *Integrated into z/VM version 4 at no additional charge*
- *Complements the CMS interactive support*
- *Can increase the productivity of your local operations*
  - *Provides tools and services that simplify and enhance the operation of CP and CMS environments for end users and application developers*
  - *Provides fully-supported commands, EXECs and applications that would otherwise need to be created locally*
  - *ACCOUNT updates to recognize specialty processors*

ibm.com/vm/related/cuf

Host Management Facilities/VM

- *Monitors subsystems and applications to help reduce outages*
- *Coordinates and simplifies performance analysis*
- *Enables increased console automation*
- *Manages local and remote systems*
- *Enables automation of subsystem and application management*
- *Enables VMSES/E installation and service*

Note: HMF was withdrawn from marketing on September 8, 2008. HMF V1.1.0, is replaced by IBM Operations Manager for z/VM (5697-J10) V1.2.0, or later. Support is planned to be discontinued on April 5, 2010.

(See Host Management Facilities/VM General Information Manual – SC24-5612)

ibm.com/vm/related/hmf

Additional Product Information

For additional information on the many z/VM technology-related products from IBM and independent software vendors, visit the z/VM Web site at:

ibm.com/vm/related/products/

Configurability

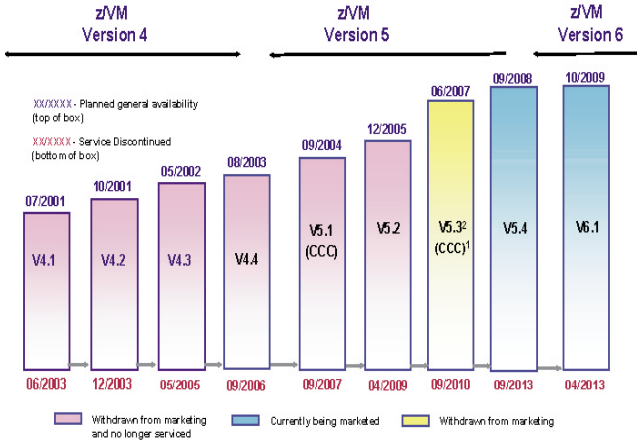
Partitioning Options

Virtual	Logical
Number of Images	
Many	15 - 60 [1]
Performance	
– Adapter-interruption performance assist for QDIO [3]- high performance for V=V guests using QDIO (HiperSockets, OSA-Express, and FCP)	Near Native
– QDIO performance assists [4](QEBSM, and HPMA - high performance for V=V guests using QDIO (HiperSockets, OSA-Express, and FCP)	
Resources	
– Dedicated or shared processors, memory and devices – Virtual devices	– Dedicated or shared processor – Dynamic memory reconfiguration – Dedicated channels, CUs and devices [2]
Support Requirements	
Hardware and Software	Hardware
Reliability	
Hardware and Software	Hardware

1. *Server-dependent (up to 15 on z900 and z800, up to 30 on the z10 BC, z9 BC, z990 or z890, and up to 60 on the z10 EC and z9 EC servers.*
2. *Channels (except parallel) may be shared on System z and S/390® servers using the Multiple Image Facility (MIF).*
3. *Adapter-interruption performance assist is available only on z10 EC, z10 BC, z9 EC, z9 BC,z990, and z890 servers;*
4. *QEBSM and HPMA are available only on System z9 and System z10 servers.*

z/VM Evolution

- *z/VM version 5 supports the z10 EC, z10 BC, z9 EC, z9 BC, z990, z890, z900, and z800 (standard, IFL, zAAP, and zIIP processors if supported on the server) in z/Architecture mode.*
- *z/VM version 6 supports the z10 EC and z10 BC servers (standard, IFL, zAAP, and zIIP processors if supported on the server) in z/Architecture mode.*



1 *Common Criteria Certification feature. IBM has recieved certification of z/VM V5.3 from the German Federal Office of Information Security - Bundesamt für Sicherheit in der Informationstechnik (BSI) for conformance to the Controlled Access and Labeled Security protection profiles (CAPP and LSPP) of the Common Criteria standard for IT security, ISO/IEC 15408, at Evaluation Assurance Leven 4+ (EAL 4+). The z/VM V5.3 CCC feature is available as a no-charge offering from IBM Resource Link™.*

2 *Withrawn from marketing on Septemeber 8, 2008*

z/VM Operating System Comparison

VM Function	z/VM V4 [26]	z/VM V5
Function		
Shared File System	•	•
Callable Services Library	•	•
Cross Systems Extensions	•	•
Virtual disk in memory	•	•
Enhanced minidisk cache	•	•
370 accommodation	•	•
CP Exit Facility	•	•
Parallel Sysplex simulation	•	•
Coupling Facility duplexing[3]	•	•
HiperSockets[3]	•	•
IPV6 HiperSockets [7, 8]	-	•
GVRP Support [6, 8]	-	•
Guest LAN [3]	•	•
Guest LAN Sniffer [7]	-	•
MPRoute Server [7]	-	•
Shared tape for guests [4]	•	•
Accounting enhancements	•	•
Systems management APIs [5]	•	•
HMC integrated systems management [9]	-	•
Installation of Linux from the HMC [10]	-	•
VMRM enhancements [5]	•	•
Virtual LAN [5]	•	•
Virtual SWITCH (VSWITCH) [5]	•	•
VSWITCH support for link aggregation [9]	-	•
HCM and HCD [5]	•	•
MQ Interface Client	•	•
PCIX Cryptographic Coprocessor [6]	-	•
Crypto Express2 [6]	-	•
Crypto Express3 [9, 27]	-	•
LDAP server and client utilities [9]	-	•
Password phrases (Passphrases) [9]	-	•
RACF password change logging [10]	-	•
Dynamic Virtual Machine Timeout [6]	-	•
VMRM enhancements for memory management of Linux guests [7, 8]	-	•
CMMA [9]	-	•
Guest ASCII console [9]	-	•
Enhanced virtual network management providing SNMP data [9]	-	•
CMS-based z/VM SSL server [10]	-	•
TCP/IP Layer 2 support [10]	-	•
Enhanced failover support for IPv4 and IPv6 devices [9]	-	•
VIPA support for IPv6 [9]	-	•
QDIO data connection isolation support [9]	-	•
TELNET support for IPv6 [10]	-	•
Storage Relief below 2 GB [7]	-	•
Dynamic memory upgrade [10]	-	•
Share redistribution [10]	-	•
Dump Linux guests to SCSI disks [10]	-	•
Linux DSR support [10]	-	•
LPARs up to 256 GB [9]	-	•
Up to 32 real processors per LPAR [9]	-	•
z/VM-mode partitions [10, 27]	-	•
Central Storage (Memory) [22]		
32 GB (z890 and z800)	•	•
64 GB (z900)	•	•
64 GB (z9 BC)	•	•
248 GB (z10 BC)	-	•
256 GB (z990)	•	•
512 GB (z9 EC)	•	•
1520 GB (z10 EC)	-	•
Expanded Storage (Memory)		
Paging	•	•
Guest	•	•
VM Data Spaces	•	•
Virtual Machine Size		
256 GB [1]	•	•
1 TB (Processor dependent) [22]	-	•

VM Function	z/VM V4[26]	z/VM V5
I/O		
FICON/ESCON I/O	•	•
FICON CTCA [3]	•	•
FICON Express2	•	•
FICON Express4	•	•
FICON Express8 [9, 27]	-	•
Extended Address Volumes [10]	-	•
Parallel Access Volumes (PAVs) as minidisks [5]	-	•
Virtual FICON CTCA [5]	•	•
Cascaded FICON Directors[5]	•	•
Guest use of FCP [4]	•	•
Guest use of emulated SCSI FCP disks[5]	-	•
CP use of SCSI FCP disks [22]	-	•
N-Port Identifier Virtualization [23]	•	•
WWPN prediction tool support [9, 27]	-	•
Guest use of MIDAWs [9]	-	•
Logical Channel SubSystems[5]	•	•
HyperSwap [6]	-	•
OSA-Express2/3 OSN [7]	-	•
OSA-Express3 [7]	-	•
OSA-Express3 four-port exploitation[7]	-	•
OSA-ICC four-port exploitation in first quarter 2010 [9, 27]	-	•
Guest Operating System		
S/370™ architecture	•	•
370-XA architecture	•	•
ESA/390 architecture	•	•
z/Architecture	•	•
Performance Assists		
I/O Assist [2, 20]	•	-
Adapter interruption performance assist for QDIOAssist [5,21]	•	•
QEBSM and HPMA [7, 21]	-	•
Systems/Processor Units Supported		
System z10 EC/z10 BC [7,#]	-	•
System z9 EC/z9 BC [5,#]	•	•
zSeries 800/890/900/990 Servers [#]	•	•
G5/G6 Servers	•	-
IFLs	•	•
zAAPs [9]	-	•
zIIPs [9]	-	•

Legend

1 Pageable guests only
2 The sum of memory for each of the preferred guests plus the memory required for the VM Control Program cannot exceed 2 GB
3 Supported on z/VM V4.2 and later
4 Supported on z/VM V4.3 and later
5 Supported on z/VM V4.4 and later
6 Supported on z/VM V5.1 and later
7 Supported on z/VM V5.2 and later
8 Requires PTF for VM63952 on z/VM V5.2
9 Supported on z/VM V5.3 and later
10 Supported on z/VM V5.4 and later
20 I/O - assist is not available when z/VM is running in a logical partition. z/VM must be run in a logical partition z10 EC, z10 BC, z9 EC, z9 BC, z990, and z890
21 Adapter-interruption performance assist is available only on z10 EC, z10 BC, z9 EC, z9 BC, z990, and z890 servers; QEBSM and HPMA are available only on z10 EC, z10 BC, z9 EC, and z9 BC
22 Supported maximum real memory per individual z/VM LPAR is 256 GB
23 Supported on z10 EC, z10 BC, z9 EC, and z9 BC
24 For installation, IPL, and operation of z/VM V5
25 z/VM V4.4 and V5 enables guest use of NPIV when FCP subchannels are dedicated to a guest. V5 provides for CP use of NPIV
26 Withdrawn from Marketing
27 Available only on the z10 EC and z10 BC
• Supported
– Not applicable
No 370-mode execution

z/VM Feature Comparison

VM Function	z/VM V4 [22]	z/VM V5
REXX Sockets	•	•
31-bit CMS	•	•
CMS Pipelines	•	•
CMS multitasking	•	•
Reusable Server Kernel	•	•
POSIX	•	•
DCE	•	-
Binder/Loader	•	•
NFS Client	•	•
APPC	•	•
Shared File System	•	•
VM Data spaces	•	•
Common SFS and minidisk interface	•	•
POSIX Byte File System	•	•
Automated SFS shutdown [5]	•	•
DFSMS/VM		
Fast data mover	•	•
Space management by policy	•	•
Automated tape library support	•	•
Operational Enhancements		
Simplified system configuration	•	•
Alternate nucleus	•	•
Fast warm start	•	•
Fast spool backup (SPXTAPE)	•	•
GVRP support [6, 8]	-	•
IPv6 HiperSockets [7, 8]	-	•
Improved VMRM enhancements for memory management for Linux guests [7, 8]	-	•
Support for CMMA [9]	-	•
Dynamic system configuration	•	•
Dynamic system configuration including Coupling-over-InfiniBand (CIB) CHPID [9]	-	•
Dynamic memory upgrade [11]	-	•
CPU share redistribution [11]	-	•
Linux DSR support [10]	-	•
Support for z/VM-mode partitions [23]	-	•
Enhanced timer management [4]	•	•
Virtual Machine accounting enhancements [4]	•	•
Systems management APIs [5]	•	•
HCD and HCM [5]	•	•
HMC integrated systems management [9]	-	•
Hypervisor-configuration tasks performed by the HMC [11]	-	•
VM Resource Manager [4]	•	•
Automated shutdown [4]	•	•
Installation from DVD	-	•
Guest ASCII console [9]	-	•
Password phrases (Passphrases) [9]	-	•
Dynamic LPAR addition/deletion	•	•
DirMaint performance improvement [7]	-	•
Coordinated DirMaint/RACF changes [7]	-	•
RACF password change logging [11]	-	•
Installation from DVD	-	•
Installation of Linux from the HMC [11]	-	•
Serviceability enhancements	•	•
VMSES/E	•	•
ShopzSeries	•	•
ESCON/FICON Architecture	•	•
Fibre Channel Protocol [4]	•	•
Device Support		
FBA DASD	•	•
TotalStorage ESS	•	•
System Storage DS4000 [7]	-	•
System Storage DS6000	•	•
System Storage DS8000	•	•
XIV Storage System [7]	-	•
Extended Address Volumes [11]	-	•
System Storage FlashCopy V2 [3]	•	•
Flashcopy SE support [11]	-	•
System Storage PPRC V2 [3, 20]	•	•
PAVs as minidisks [7, 8]	-	•
HyperPAV [9]	-	•
SVC Storage Engine 2145 [7]	-	•

VM Function	z/VM V4 [22]	z/VM V5
RAMAC® DASD Subsystem	•	•
RAMAC Array Sub System	•	•
3390 DASD	•	•
3990 Model 6 MPLF Support	•	•
9340 DASD Subsystem	•	-
3494 Tape Library Subsystem	•	•
3495 Tape Library Dataserver	•	•
3590 Tape Drive	•	•
3592 Tape Controller (J70 [5] and C06 [7])	•	•
3592 Tape Drive (J1A [5], E05 [5], and E06 [7])	•	•
9348 Tape	•	-
3995 Optical Library Dataserver	•	-
Minidisk Cache	•	•
Networking		
HiperSockets [3]	•	•
HiperSockets using IPv6 Protocol [7, 8]	-	•
QEBSM and HPMA [7, 21]	-	•
Support for GVRP [6, 8]	-	•
TELNET support for IPv6 [11]	-	•
CMS-based z/VM SSL server [11]	-	•
TCP/IP Layer 2 support [11]	-	•
QDIO data connection isolation support [9]	-	•
OSA-Express		
1000BASE-T Ethernet	•	•
Gigabit Ethernet (GbE)	•	•
Token-Ring [3]	•	•
OSA-Express2		
1000BASE-T Ethernet	•	•
GbE	•	•
10 GbE	•	•
OSA-Express3 [7, 23]		
1000BASE-T Ethernet [24]	-	•
GbE [24]	-	•
10 GbE	-	•
System Management Products or Features		
HMF [22]	•	•
VMPAF [22]	•	•
PRF Feature [22]	•	-
RTM Feature [22]	•	-
Performance Toolkit for VM Feature [5]	•	•
DirMaint 1.5 [22]	•	-
DirMaint Feature	•	•
RACF for VM 1.10 [22]	•	-
RACF Feature [4, 10]	•	•
RACF Security Server Feature [9]	-	•
IBM Tivoli zSecure Manager for RACF z/VM [6]	-	•
IBM Tivoli OMEGAMON XE on z/VM and Linux V4.1 [7]	-	•
Communications		
RSCS Feature [9]	-	•
RSCS 3.2.0 [10, 22]	•	•
ACF/VTAM V4.2	•	•
TCP/IP for z/VM [2]	•	•
VM Passthrough Facility (PVM)	•	•
Additional Features		
OSA/SF	•	•
Shell & Utilities [1]	•	•
CMS Utilities [2]	•	•

Legend

1 Integrated in z/VM
2 Integrated in z/VM V4 and later
3 Supported on z/VM V4.2 and later
4 Supported on z/VM V4.3 and later
5 Supported on z/VM V4.4 and later
6 Supported on z/VM V5.1 and later
7 Supported on z/VM V5.2 and later
8 Requires PTF for VM63952 for z/VM V5.2
9 Supported on z/VM V5.3 and later
10 Not supported on z/VM V5.3 or later
11 Supported on z/VM V5.4 and later
20 Guest use only
21 Adapter-interruption performance assist is available only on z10 EC, z10 BC, z9 EC, z9 BC, z990, and z890 servers; QEBSM and HPMA are available only on z10 EC, z10 BC, z9 EC and z9 BC
22 Withdrawn from Marketing
23 Available only on the z10 EC and z10 BC
24 Four-port exploitation by z/VM V5.2 and later

• Supported
– Not applicable

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